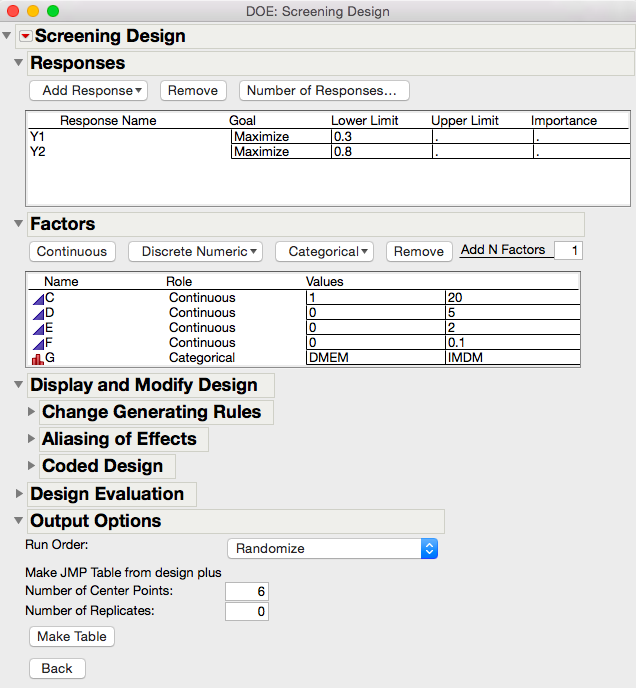
**Experimental Strategy:**

For the first data request, we used a fractional factorial to screen the effects of factors A, B, C, D, E, F, G on Y1 and Y2. For each batch request, we were limited to 70 runs. For a full factorial design of 7 factors, we would need 2^7 = 128 runs, which was not possible therefore we did a one half fraction of the 7 factor factorial design, so we could maximize the number of runs in the screen. We requested 2^7-1 = 64 run factorial with six centre points to determine the curvature of the regression model.

What are the aliases?



After analysis of the screen, we narrowed found that factors A, B, C, and D were significant, as per ANOVA described below, and we decided to do a rotatable central composite inscribed design with six centre points.

ccd: alpha = (2^k)^0.25 = 2, 6 centre points, CCD rotatable, inscribed

Since we expect to have a response surface model, a rotatable CCD is a desirable property for the quadratic model design as the variance of the predicted response at any point x depends only on the distance from x to the center point. Also, we chose CCI (inscribed) because the axial points cannot exceed the +1, -1 limits of the design (which are the maximum and minimum levels of A, B, C, D, E, F.

Alpha = [number of factorial runs]^1/4 = [2^k]^0.25 for a rotatable design

Identify the Significant Factor Effects and Interactions:

Data Analysis 1: (Screen Test)

|  |  |  |
| --- | --- | --- |
| Factor | Effect on Y1 | Effect on Y2 |
| A |  |  |
| B |  |  |
| C |  |  |
| D |  |  |

Data Analysis 2: (Response Surface Model)

|  |  |  |
| --- | --- | --- |
| Factor | Effect on Y1 | Effect on Y2 |
| A |  |  |
| B |  |  |
| C |  |  |
| D |  |  |

Analyze data Batch 1 – Fit Model

exclude centre points -> fit model for 3 interactions

Use diagnostic tests – anova and t test

Ensure assumptions are satisfied

Find proper method to analyze data satisfying the assumptions and do all the proper tests

Then request data

Evaluate design – colour map on correlation

For ccd determination: what is the best alpha? Use the colour map on correlation

* Can use for example alpha = 1.8 - > set -1 = -1.8 and 1 = 1.8 and recode the values

ANOVA Assumptions = normally distributed residuals, observations are independent, variance is the same for all groups

Linear regression assumptions include:

* the means of response variable are accurately modeled by a linear function of the factors.
* The random error term is assumed to be normally distributed with a mean of zero and constant variance
* Errors are independent

By analyzing the residuals to determine model adequacy, the following assumptions can be checked:

* Errors are approximately normally distributed with constant variance
* If data transformation or additional terms in the model would be useful

This is what the Y2 residuals look like:

We did a log transform because before the residuals did not look good. Therefore, when we transform Y2 to log10Y2, and here is the corresponding residual analysis:

Is the F ratio affected when transformed?

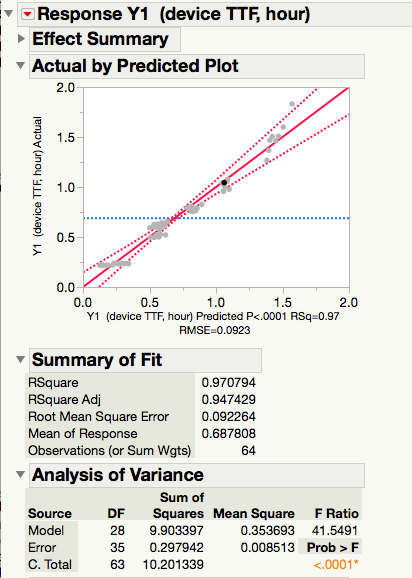
Y2 significant factors with linear regression =

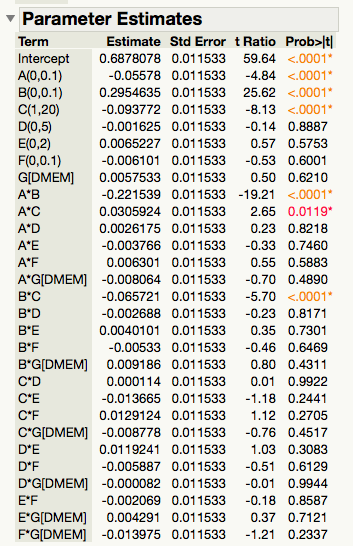
Y2 significant factors with logy2 transformed linear regression =

In the transformation: What is alpha? What is the relationship between mu and sigma? To determine the transformation see ch 15 slide 17 for the table

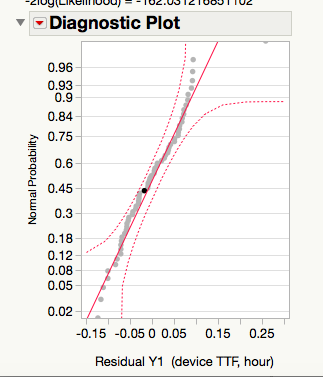
Y1 Fit Model

Removed centre points

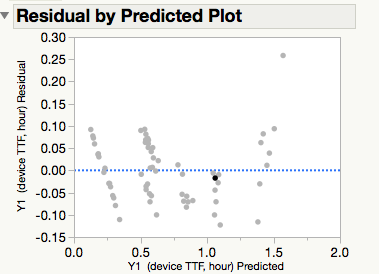




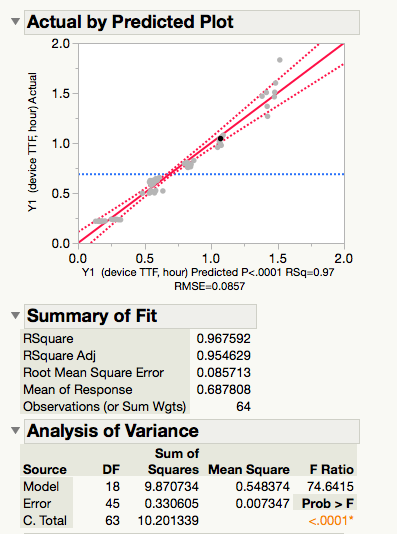
Therefore, A, B, C are significant factors and AB, AC, BC are the significant interactions

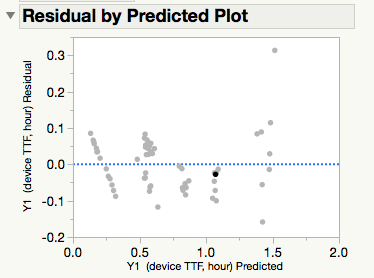


therefore residuals are normally distributed – satisfying ANOVA assumption

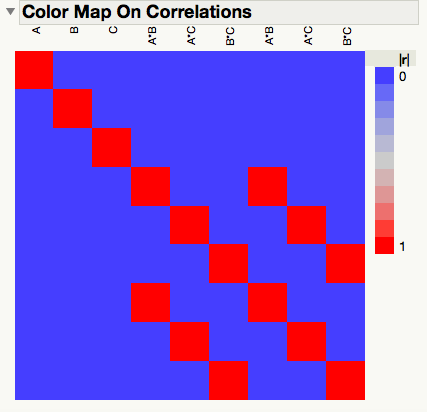


Y1 analysis with significant factors (ABC):





colour map on correlation for significant factors:



no correlation between factors

Finding the response suface – will generate a model that can be used to interpolate the best factor levels to achieve the best trade off for the factor goals

Factor goals: Y2

Y1:

Factor constraints: